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ABSTRACT

This report is intended to assist curriculum developers, administrators, and teachers in the Technical and Further Education (TAFE) system in deciding if and when it is appropriate to introduce individualized systems of instruction in their programs. The first section explains what individualized instruction is and examines the reasons for the recent increased interest in this instructional method. The next section, which addresses the important variables found in the research literature, suggests that while there are no advantages to self-pacing over group-pacing per se, the individualized approach (particularly Keller's Personalized System of Instruction) generally produces small but significant improvements in student achievement at the secondary level. This approach also appears to produce favorable outcomes because of its use of small steps and requirement of mastery and provision of feedback at every step in the learning process. Evidence supporting the increased benefits of cooperation compared to competition (conventional instruction) or individualistic efforts (individualized instruction) is also provided. The next section compares individualized systems of instruction currently in use in New South Wales, Victoria, and South and Western Australia. The final section discusses the main conclusions drawn from the study with respect to development and implementation of individualized programs including various innovations that have been or are being introduced in TAFE; instructional features and educational outcomes; important student, course, and individualized instruction variables in implemented programs; and curriculum development. Three pages of references are provided. (MN)

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INDIVIDUALIZED SYSTEMS OF INSTRUCTION IN TAFE COLLEGES

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PREFACE

Individualized systems of instruction are growing in importance in Colleges of Technical and Further Education (TAFE) in Australia. This project, funded by the TAFE National Centre for Research and Development, was designed to assist curriculum developers, division heads, heads of schools, head teachers and TAFE instructors in deciding if and when it is appropriate to introduce individualized systems of instruction.

This report consists of a review of research on individualized instruction, in particular the components responsible for its effectiveness, and an examination of some individualized courses that have been implemented in TAFE. The aim was to determine the variables that are relevant in the choice and development of individualized systems of instruction, and which aspects of individualized systems are particularly applicable with which types of students and with which types of courses of study in TAFE. The project was designed to assist the development of individualized instruction in TAFE and suggest new options. The main question addressed was: What are the important variables?

The report was prepared by Dr Joy Thompson, educational psychologist, Nicholas Clark and Associates, Canberra.

In common with all commissioned reports, the views expressed do not necessarily reflect those of the Board or staff of the TAFE National Centre for Research and Development.

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This report depended on cooperation from the many TAFE staff who took the time to discuss individualized instruction. I would like to thank all those involved.

SUMMARY

Currently, interpersonal competition is being replaced by individualistic work in programs of study in TAFE in Australia. Individualized instruction tends to be defined in the classroom as individual study, with the most popular feature being the self-pacing component.

An examination of the empirical basis of many aspects related to individualized instruction reveals that some are educational rhetoric. For instance, the achievement results clearly demonstrate that there are no advantages of self-pacing over group-pacing. Furthermore, there are practical student difficulties of procrastination. This compounds teacher difficulties of provision of extra learning time and extra activities.

Why, then, the persistence in TAFE in developing "self-paced" programs of study? Comparisons of individualized and conventional teaching at levels above secondary school show that individualization generally produces small but significant improvements in student achievement. The improvements are more pronounced when Keller's Personalized System of Instruction is used, and in courses other than the "hard" sciences. Often, these newly-developed individualized programs feature: small steps; a requirement of mastery at every step; and immediate feedback at every step. These are the variables that appear to make for a successful program, not self-pacing per se. They can be successfully incorporated in conventional teaching or in group-paced programs.

Another research area provides strong evidence that cooperation produces higher achievement and productivity than either competition (under conventional teaching) or individualistic efforts (under individualized and self-paced instruction). Furthermore, there are no significant achievement differences between interpersonal competition and individualistic efforts per se. Cooperative learning fosters higher student achievement and has the potential to develop interpersonal skills necessary for vocational graduates.

These conclusions have considerable generalizability, being

confirmed by many studies using subjects of different ages and backgrounds and working in different subject areas on a wide variety of tasks including motor performance, concept attainment, problem solving (both verbal and spatial), categorizing, retention and memory, and guessing-judging-predicting.

These findings have important implications for the education of TAFE students.

1. THE CONCEPT OF INDIVIDUALIZED INSTRUCTION

1.1 Why the interest in individualized instruction?

The most effective method of instruction is one-to-one tutoring (Bloom, 1984). This is the basis of the traditional master craftsman-apprentice relationship. Group based instruction at a technical college or trade school supplemented one-to-one on-the-job learning by providing classes focusing on trade theory, calculations, drawing, and trade practice. These were taught by conventional methods, usually as separate, non-contiguous subjects.

As a result of the combination of a number of economic and technical forces, including specialization in the workforce, colleges are accepting more and more of the responsibility for providing high quality training for tradesmen and technicians. Conventional classroom instruction is giving way to performance-based training featuring emphasis on student attainment of instructional objectives, typically performance objectives derived from job analyses, and featuring integration of theoretical and practical aspects of a topic. The search is on for methods of instruction more appropriate and more effective for performance-based college education than conventional classroom "chalk and talk". The search is for methods of group instruction that approximate one-to-one tutoring. Individualized Instruction is one such possibility.

1.2 What is individualized instruction?

Individualized systems of instruction are growing in importance in technical education and trade training. Individualized instruction tends to be defined in the classroom as individual study, with the most popular feature being the self-pacing component. However, this is only one of the features of individualized programs, and it may not be an important or even an essential feature.

Individualized systems of instruction typically refer to teaching systems in which students work at their own rates through carefully designed units of course material with the

help of study guides and diagnostic tests (Kulik, 1982). These teaching systems typically feature:

- division of work into units;
- use of "learning activity packages";
- individualized work at the student's own rate; and
- formative testing for student mastery of each unit of work.

Major systems, all closely related, are:

- Keller's Personalized Systems of Instruction (PSI)
- Postlethwait's Audio-Tutorial Approach (A-T)
- Programmed Instruction (PI)
- Computer-Assisted Instruction (CAI)

Programmed Instruction involves carefully sequenced short units, step-by-step progress, overt learner responses, and immediate feedback. Computer-Assisted Instruction is a contemporary offshoot of programmed instruction where computers are used for tutoring and for drill and practice. The Audio-Tutorial Approach involves independent study sessions using audiotapes of lectures and other visual and manipulative materials, weekly general assembly sessions for lectures, films, and exams, and weekly integrated quiz sessions. (Kulik, 1982). The Personalized System of Instruction is described in Section 2.4.

Individualized instruction does not include other approaches to teaching that are designed to accommodate differences among learners. Open classrooms, individualized assignments, learning contracts or individualized projects do not share the main features of individualized systems of instruction outlined above. They are not dealt with in this report.

There is a growing expertise in TAFE in individualized instruction, as reflected in the following selected articles and reviews:

Seymour, M. (1979) Programmed Instruction for Higher Education.

Macdonald, C. (1980) Individualized Instruction in Vocational Education.

Pearson, M. (1981) A Review of Individualized Instruction

and Self-Paced Learning.

Bird, M. T (1981) The Quiet Revolution: Self-Paced
Apprentice Training.

Locke, T. (1981) The Implementation of Mastery Learning and
Individualized Instruction in Technical Education.

McDonald, T. (1982) Modules: Self-Paced Learning, Mastery
Learning, Competency Profiling.

Pearson, M. (1983) Approaches to Individualized Instruction
- A Review.

2. THE IMPORTANT VARIABLES IN THE RESEARCH LITERATURE

The implications of the research literature on individualized instruction are important for technical and further education. Research studies provide meaningful answers to some major questions: Is individualized instruction an effective teaching method? How effective is it? What makes individualized instruction effective? For whom is it effective? Under what conditions is it especially effective? What are the implications for TAFE? What other options could be considered for TAFE?

This section presents results from major analyses of the effects of individualized instruction that answer those questions.

2.1 What is the research base?

The growth in interest in individualized teaching has resulted in publication of hundreds of research studies carried out in many different, specific settings and yielding diverse findings. Conventional reviews seldom reach firm conclusions. Within the last 3 years, research reviews have been aided by the rapid growth of the meta-analysis literature.

Meta-analysis (Glass, 1976) is a method for synthesizing a collection of research studies. The technique is an extremely powerful and sensitive statistical tool, and brings findings from many studies into sharp focus. It permits overall analysis of effectiveness and of the size of the effect produced, as well as detailed component analysis of the variables responsible for the effects obtained.

The research presented here is based on meta-analyses. Kulik and colleagues (1979 a,b, 1980 a,b,c) have synthesized 213 independent research studies conducted by many different researchers in actual college classrooms. The studies have been located through broad searches and carefully screened for major methodological flaws, and all involve quantitative comparisons of outcomes of individualized and conventional teaching. The research studies were conducted at the tertiary level in different types of educational

institutions mostly in the United States; doctorate-granting universities, comprehensive colleges, liberal arts colleges, and community colleges.

The conclusions presented here, then, have a strong empirical base of meta-analyses of hundreds of independent research studies carried out in actual college classrooms. From these meta-analyses it is possible to draw a reasonably definitive picture of the effectiveness and importance of variables involved in individualized instruction.

Meta-analysis is now being used widely in the behavioural sciences instead of the traditional review. "Because of the systematic and explicit processes involved in meta-analysis, the method has the potential to provide an authoritative summary of the state of knowledge in an area" (Over and Lancaster, 1985, p 2). The method enjoys wide acceptance in many fields including education (Fitz-Gibbon, 1984, 1985). Seven major conventional reviews of PSI (listed in Kulik, Kulik and Cohen, 1979 (a), p 309) reach similar conclusions to the meta-analysis. Kulik and colleagues conclude: "This meta-analysis of research on PSI supports the major findings of less formal reviews of PSI effectiveness, but meta-analysis brings these findings into sharper focus" (Kulik, Kulik and Cohen, 1979 (a), p 317).

The research on components of individualized instruction applies to cognitive achievement in subject-based courses. There is a lack of rigorous research on either competency-based vocational education or instructional methods to enhance psychomotor skill development. Application of the findings of the Kulik meta-analyses in the areas of trade training should be approached with some caution because of this deficiency.

It should be noted that the research studies focus on student achievement and student attitudes. Individualized systems of instruction can be implemented for reasons other than to increase student achievement or attitudes, but the effects on these variables are important.

2.2 Is individualized instruction an effective teaching method?

How effective is it?

Meta-analyses of 213 studies of individualized versus conventional teaching have been carried out by Kulik and associates for:

1. Programmed Instruction
2. Computer-Assisted Instruction
3. Keller's Personalized System of Instruction, and
4. Postlethwait's Audio-Tutorial Approach

The effects on student achievement at the tertiary level are similar for Programmed Instruction, Computer-Assisted Instruction and Postlethwait's Audio-Tutorial Approach. These methods each raise final examination scores by about 3.0 percentage points. This is equivalent to moving the average student from the 50th percentile to the 60th percentile. This is a modest achievement only. By and large there is no difference in student attitude ratings given to these classes than to conventional classes, and no difference in student withdrawal rates. There are two exceptions to these statements. Firstly, more recent studies show a stronger, more favourable effect of Programmed Instruction than older studies. Secondly, Computer-Assisted Instruction required less student study time, reducing to two-thirds the time required by conventional teaching.

The effects are much more pronounced for Keller's PSI which raised final examination scores by an average of about eight percentage points. The final exam score was 73.6 percent compared to the typical conventional class average of 65.9 percent. This is equivalent to moving the average student from the 50th percentile to the 70th percentile or from average to above average performance. Students rated PSI classes as more enjoyable, more demanding and higher in overall quality than conventional classes. There were no differences in withdrawal rates or student study time.

The superiority of PSI over conventional instruction was especially clear on delayed retention measures. PSI produced an improvement of about 14 percentage points on exams administered several months after the end of a course.

Individualized instruction, then, is an effective teaching method especially when achieved through Keller's Personalized System of Instruction. This method raised final examination scores by about eight percentage points, and was rated more favourably by students. Individualized instruction is less effective when achieved through Programmed Instruction, Computer-Assisted Instruction, or Postlethwait's Audio-Tutorial Approach. In each of these cases, however, achievement is slightly higher under individualized than under conventional instruction.

2.3 For whom is it effective?

Under what conditions is it especially effective?

The superiority of PSI is clear under a variety of conditions; the meta-analysis of 75 comparable PSI studies revealed similar findings in different types of colleges and for courses at different levels. Although it is not yet clear from the research what type of student is helped most by PSI and for what types of courses and materials, it is clear that no combination of students X materials has been found for which PSI is less effective than conventional teaching.

PSI effects tended to be somewhat more pronounced for open-ended essay exams than for objective, multiple choice items, suggesting that PSI is equally effective for teaching higher level cognitive skills as for acquisition of facts. In the physical and life sciences and in the social sciences PSI final exams averaged 5 points higher than exams in conventional classes. In mathematics and engineering and psychology, PSI-conventional differences averaged 9 points. PSI was equally effective at universities, comprehensive colleges, liberal arts colleges and community colleges. The superiority of PSI to conventional instruction can be seen as clearly with high aptitude students as with low aptitude students; aptitude-achievement correlations are not reduced. (Bloom's (1968) mastery model would suggest that PSI will have a much more marked effect on the performance of low aptitude students hence reducing aptitude-achievement correlations).

Similar patterns of results were obtained from studies of

pure PSI classes and from those in which PSI classes deviated only slightly from Keller's model. When the conventional instruction included some characteristics of PSI instruction (eg. frequent quizzes, study guides, teaching assistants), the differences between conventional and PSI classes were reduced. Differences between conventional and PSI classes were reduced when the same instructor taught both classes (as for computer-assisted instruction). Kulik et al. (1980) suggest that involvement of teachers in innovative approaches to instruction (outlining objectives, constructing lessons, preparing evaluation materials) may help teachers do a better job in their conventional teaching.

For Programmed Instruction, Computer-Assisted Instruction and Postlethwait's Audio-Tutorial Approach, the meta-analyses revealed similar findings in "hard" and "soft" disciplines, in pure and applied areas, in life studies, and other content areas, and for courses at different levels and in different types of colleges. Nor are aptitude-achievement correlations reduced; the results apply as equally to high-aptitude students as to low-aptitude students. The findings on effectiveness and size of the effect produced, then, appear to have considerable generalizability. Furthermore, the same findings emerged for different uses of Programmed Instruction and Computer Assisted Instruction. Only two results vary this picture. For Programmed Instruction, treatment effects were stronger and more favourable in recent years, suggesting perhaps use of better programs than older studies. And differences between Computer-Assisted Instruction and conventional instruction were less effective when the same teacher taught both classes, suggesting a carry-over effect.

The effectiveness of PSI individualized instruction is clear under a variety of conditions, in different types of colleges, for courses at different levels, in different subject areas, with subjects of different backgrounds and ages working on a wide variety of tasks, and for low and high aptitude students. Even when PSI versus conventional differences in student achievement are reduced, such as for "hard" sciences, or when the same instructor taught both classes, the PSI superiority is still quite apparent.

2.4 What makes Keller's Personalized System of Instruction (PSI) effective?

PSI courses typically feature:

- (1) unit mastery requirements,
- (2) self-pacing,
- (3) reliance on individual instructional materials, usually written, with
- (4) occasional lectures and demonstrations to motivate students, and featuring
- (5) student proctors (used for repeated testing, immediate scoring, tutoring, and to provide continuing personal, social interaction).

Three major conventional reviews of research on methodological variations of PSI and reasons for the effectiveness of PSI have produced similar conclusions (Bond et al., 1975; Kulik et al., 1976; Robin, 1976). The results below are based on these research reviews. Kulik and associates (1976) summarize:

PSI is effective because it puts into practice what many educators preach. In PSI courses, students move through material step by step, they receive feedback at every step, and they continue to work on each step until they can demonstrate mastery. The more distinctive and controversial features of PSI have apparently played a less important role in its instructional success: the absence of lectures, the presence of proctors, and the provisions for self-pacing. (Kulik et al., 1976, p 27)

PSI is most effective with short units (hence frequent testing) that engage students for about 3 to 5 hours. When units become too long, its effectiveness deteriorates. Achievement is high when feedback is immediate, and is significantly lower when feedback is delayed until the next class. Study guides (study objectives) also contribute to achievement. When the mastery requirement (100% correct with repeated testing) is relaxed (60% correct or unable to repeat test), performance declines.

There is NO evidence regarding the importance of self-

pacing. Teacher-paced and self-paced groups perform equivalently; limiting self-pacing has no effect on academic achievement. The presence or absence of lectures appears to have no effect on exam performance, withdrawal rates, or student ratings of the course. Finally, there is no clear evidence that the (external) proctor has a significant major effect apart from providing immediate feedback (which can be provided in other ways). There is some suggestion in the research literature that proctoring increases student achievement and work rate not only through providing task-oriented feedback but also through the social interactions. Furthermore, internal proctoring produces equal performance to external proctoring, but also benefits the proctors.

PSI works, then, because it involves:

- small steps and frequent testing
- study guides and objectives
- immediate and specific feedback at every step, and
- a requirement of mastery at every step.

For PSI instruction to be effective, the following are not necessary:

- self-pacing,
- absence of lectures, and
- presence of proctors.

PSI is based on learning theory and the experimental analysis of behaviour. "Few other modern educational innovations are so closely tied to a theoretical base" (Sherman, 1976). Researchers have been drawn to comment:

Conventional teaching methods usually give too little attention to principles of instructional design.

(Kulik et al., 1976, p 27)

and

...the achievement and attitude superiority for PSI so widely reported in the literature may not be so much due to any intrinsic superiority in the PSI strategy as due to the relative inferiority in the manner in which (conventional) instruction is presently practiced in many institutions (Thompson, 1980, p 372).

PSI, then, provides a systematized way of building in very

desirable instructional design features and provides a systematized way of improving the teaching-learning process.

2.5 Are individualized systems of instruction effective at secondary school level?

Research results on the effectiveness of individualized systems of instruction at the secondary level are in striking contrast to results at tertiary level presented above. Bangert et al. (1983) meta-analysed 51 studies on individualization conducted in secondary school classes. The individualized systems of instruction selected featured: division of work into units, use of "learning activity packages", and formative testing. These are some of the features shown to be effective in PSI. Not all of the systems included were self-paced, and not all required mastery of each unit.

Main individualized systems included were PSI, Individually Prescribed Instruction or IPI (Glaser and Rosner, 1975), and PLAN, Program for Learning in Accordance with Needs (Flanagan et al. 1975). These are two computer-managed individualized systems used extensively at primary and secondary school level. They both follow a basic diagnostic-prescriptive teaching cycle focused on large sets of carefully formulated learning objectives. They feature testing for mastery and continuous progress (Kulik, 1982).

Individualized instruction had a negligible effect on student achievement at the secondary level. In the typical study, the final exam score was at the 54th percentile for the individualized class compared to 50th percentile for the conventional class. It did not seem to make any difference whether the individualized system requires mastery or not, or whether the system uses self- or teacher-pacing. Subject matter and use of visual or auditory media did not alter the results. The findings were generalizable across a variety of academic settings. In addition, individualized systems of instruction did not affect student self esteem, critical thinking ability or attitudes toward subject matter.

The research results suggest that, as educational level increases, the relative advantage increases for individualized systems of instruction. Bangert et al.

(1983) speculate:

The uniquely strong results from such college-level applications may reflect a good fit between characteristics of college learners and features of individualized systems. Compared to elementary and secondary school pupils, college students are a select group of learners who have mastered basic skills and are learning to use complex concepts and symbols, to make subtle discriminations, and to form independent judgements. In addition, college students are used to coping in a uniquely free learning environment in which they can choose among fields, courses, and teachers. They are used to making decisions about when, how and how much to study for each of their courses. College students may therefore be uniquely prepared to work under the conditions of independence and freedom that individualized systems offer. They apparently profit from working by themselves for a few days on a unit of material before receiving an individual evaluation and a prescription for further work.

Elementary and secondary school students, on the other hand, may need more stimulation, guidance, support, and constraint than individualized systems ordinarily provide. Meta-analytic evidence suggests that other innovative approaches to elementary and secondary school teaching may provide the needed support. The meta-analytic evidence is clear, for example, on the effectiveness of computer-supported instruction at the secondary level. Interactive computer programs apparently keep youngsters interested and actively responding while guiding them easily from one level of difficulty to another. The result appears to be better learning. Evidence is also good that the social support provided in programs of peer- and cross-age tutoring has a beneficial effect on student learning in secondary schools. Indeed, even in our results on study features and effects of individualized systems, we found a hint that social support might make a difference: the group-paced individualized systems appeared to produce stronger effects than did self-paced systems. Although this result rested on the uncertain evidence of only four comparative studies of

group-based systems, it too suggested that social support may be critical for students at the secondary school level (pp 152-153).

The meta-analytic research results, then, present significantly different pictures for secondary level and college level students. At the secondary level, individualized instruction has a negligible effect on achievement, while students perform better with computer-assisted instruction. At the college level, the reverse is true. Secondary level students appear to need more guidance and support than college level students. The relevant variables may be student maturity and educational level.

2.6 What are the implications for technical and vocational education?

The methods of individualized instruction discussed above have been used and researched in tertiary colleges in subject based courses for learning of knowledge and for higher level cognitive skills. Are they relevant to vocational education?

The demand for more occupationally relevant content in technical and vocational education has led to emphasis on competency-based education. Much effort in individualizing has gone on in conjunction with competency-based vocational education (Finch, 1982). Here the model which forms the basis of the approach is PSI (McMichael, 1975; Harris and Schutte, 1984, pp 5-6). The initial use of the printed text in PSI has evolved to incorporate teaching based on audio-visual or other visual aids. The essential features remain, namely the requirement of unit mastery, use of objectives and study guides, small steps, feedback at every step, and the use of instructors as proctors. Competency based education is characterized by specification of required competencies and criteria, assessment of competence in applied settings, use of student competence to determine progression, and facilitation of student achievement of specified competencies (Finch, 1982). For a more detailed delineation of competency-based education see Section 3.3.

Although the research base is lacking for Competency-based vocational education (CBVE) in the technical and vocational

education area, in a comprehensive review of CBVE, Knaak observes that "very few educational concepts in recent years have had as great an impact on educators and on society as competency-based education" (Knaak, 1977, p 1). CBVE has not been without critics. Moss (1981) claims it is inappropriate and inefficient when applied to the higher skilled and technical occupations and to the preparation of vocational teachers and administrators. He states that two critical aspects of CBVE restrict its effectiveness to learning situations requiring little cognition, namely the focus on actual occupational tasks and the use of criterion-referenced performance on actual tasks as the main or sole measure of student learning. There is some evidence, for instance, that competency-based teacher education for vocational education teachers develops teaching skills without developing a sufficient cognitive base (Walker, 1981; Walker, Merryman and Staszkievicz, 1984). However, the main problem may be that the effective and powerful job and task analysis tools that exist for skills and technical training do not exist for management and subject-matter training (Swanson, 1982).

There has been a marked lack of research to determine which of the individualized instruction components enhance psychomotor skill development, in contrast to the research on cognitive achievement. One study (Mevarech, 1983) on acquisition of psychomotor application skills in mechanics classes, compared individualized classes with and without the mastery requirement (the feedback-corrective procedure). The mastery learning requirement led to significantly higher psychomotor ability.

Individualized instruction is appropriate for both subject-based courses and skill-based courses. Skill acquisition and skill development are learning activities which involve not only the psychomotor domain but also the cognitive, affective, and perceptual domains (Padelford, 1983). Psychomotor application skills, or behavioural sequences of learned responses used in the solution of new psychomotor problems also involve cognitive and perceptual as well as psychomotor dimensions. It is certainly feasible that the same learning principles underlie both cognitive and psychomotor skill acquisition. And it is more than likely that the components of individualized instruction found to

be effective in cognitive skill acquisition are also those effective in psychomotor skill acquisition.

2.7 Military technical training

Job skill training is a major concern in the armed services and extensive training research is conducted, particularly in the United States. Some of the more systematic approaches to instruction in technical fields have been developed by various branches of the United States military. The Defense Technical Information Centre (DITC) acts as a clearinghouse for Department of Defense documents relevant to training research and development. However, Finch (1982) notes that "it is extremely difficult to document the extended nature of training research in the armed services". Individualized instruction methods in the military include Technical Hands-On-Training System, computer-based instructional systems, the Generalized Maintenance Trainer Simulator, and self-paced training at initial entry level (Finch and Falls, 1982).

Self-paced instruction is used in initial entry training as a means of increasing performance-oriented training (Finch and Falls, 1982). Typical instructional procedures are:

1. The student works with either printed or audio-visual lessons which present the relevant theory and describe specific job task procedures.
2. After interacting with the lesson, the student practises the job task on an actual piece of equipment or a simulator.
3. The student is then expected to demonstrate mastery of the job task prior to moving to the next lesson.

An assessment of self-paced initial entry training revealed that training is enhanced when senior managers, training developers, and instructors are competent in the area of self-paced instruction development (reported in Finch and Falls, 1982).

The Instructional Systems Development (ISD) model is a widely accepted approach to the design of training programs in the U.S. armed services (Campbell, 1984). The five

phases of the model are: analyze, design, develop, implement, and control. The procedures are characterized by rigorous derivation of training requirements from job requirements, selection of instructional strategies to maximize the efficiency of training, and interactive trial and revision of instruction during development until training objectives are met. The ISD model provides general learning guidelines:

1. Inform the learner of the objectives.
2. Provide for active response.
3. Provide for guidance and prompts.
4. Provide for feedback. (Finch and Falls, 1982).

The U.S. Navy and Air Force have prepared a large selection of performance-based, criterion-referenced courses using ISD methodology.

There are obvious similarities between public sector and military technical training, and methods and procedures have evolved along parallel lines. However, there are important differences. "It should be kept in mind that the military service has a reasonable amount of control over student input to technical training programs as well as over placement of graduates and what their job responsibilities will be. This span of control enables military training specialists to provide more narrowly defined, in-depth experience for their students" (Finch and Falls, 1982, p 1940).

2.8 What other options could be considered for TAFE?

1. Bloom's Mastery Learning Instructional Method

The Mastery Learning Method of Instruction as originally formulated by Bloom (1976) is based on group instruction. Formative tests are given for feedback. Most importantly, these are followed by corrective procedures and parallel formative tests to determine the extent to which the students have mastered the instructional objectives. The feedback-corrective process consists of the teacher reteaching the aspects that the majority of students missed, small groups of students helping each other over aspects

that have been missed, and students individually reviewing aspects they were not sure about by referring to the designated pages in the instructional material. Internal proctoring also can be used. Bloom's Mastery Learning Method is characterized by this feedback-corrective procedure. It does not require implementation of individualized systems of instruction or self-paced instruction, though it is a common misconception that it does. However, the problems of providing practical training under group-based instruction and progression are noted later.

Studies carried out confirm the superiority of the mastery learning feedback-corrective strategy over conventional instruction. It was typically found that the average student under mastery learning was above 84% of the students in a conventional class (Bloom, 1984).

Mastery Learning Programs have been implemented successfully on a group instruction basis in 2 year colleges in the United States (Guskey and Monsaas, 1979). Mastery learning provides a systematized way of utilizing important instructional design variables in a group instruction situation, and provides an important option to individualized instruction when the purpose is to improve student achievement through improving the teaching-learning process.

2. Cooperative Learning Methods

Cooperative Learning Methods employ small teams of students to promote peer interaction and cooperation. These teams become the social unit in which learning is pursued, rather than the unit being the whole class or the individual student. A variety of cooperative learning methods have evolved, based largely on either peer-tutoring methods or group-investigation approaches.

The results of the meta-analysis by Johnson et al. (1981) confirm that cooperation is considerably more effective than either interpersonal competition or individualistic efforts in promoting achievement and productivity. (Individualistic efforts here mean individual work not individualized systems of instruction). These conclusions have considerable

generalizability. They hold for all subject areas, (language, arts, reading, maths, science, social studies, psychology, and physical education), and for tasks involving concept attainment, verbal problem solving, categorizing, spatial problem solving, retention and memory, motor performance, and guessing-judging-predicting.

The effects hold also for all age groups, but the results were stronger for precollege than for college students. Precollege students benefitted more from cooperative learning. This dovetails with the results noted above that precollege students may function better in a more supportive environment and that they do not appear to benefit from individualized systems of instruction other than CAI. There is evidence also that Australian secondary school students prefer a cooperative classroom learning atmosphere rather than a competitive or individualized one (Owens and Barnes, 1982).

Cooperative learning, besides fostering student achievement and cognitive growth, has positive effects on social variables. It has positive effects on students' attitudes, mutual concern among students, student self-esteem, and on ethnic relations. (Sharan, 1980; Slavin, 1980). A peer instruction model in military technical training has been shown to improve job preparation, produce highly motivated students, and reduce training time and costs (reported in Finch, 1982).

Tjosvold et al. (1981) argue that cooperation is a more constructive approach for vocational students, and that both the traditional competitive educational process and individualized instruction produces students lacking in interpersonal skills. Cooperative learning methods can contribute substantially to the preparation of students who are both technically skilled and interpersonally competent, and hence better prepared for the world of work.

3. INDIVIDUALIZED SYSTEMS OF INSTRUCTION IN TAFE

Selected implemented systems of individualized instruction in TAFE in Australia are reviewed to provide answers to these questions: What types of individualized systems of instruction exist in TAFE in Australia? Are they effective? For whom are they effective? What are the implications for other TAFE courses? What other options could be investigated?

The development of individualized instruction in four States was reviewed. These cover a range of developmental and implementation stages and a variety of courses. New South Wales provides an example of a TAFE system where individualized instruction is being investigated but has not been implemented. Victoria has a relatively long history of individualized programs, and provides an overview of the varieties of established implemented systems to be found in TAFE. South Australia and Western Australia provide examples of recently implemented individualized TAFE programs. This section presents these reviews as a basis for analyzing what are the important variables in the establishment and maintenance of individualized programs, and as a basis for formulating answers to the above questions.

3.1 New South Wales

New South Wales TAFE institutions, like other educational institutions, have a continuing tradition of individual instruction, both on an informal basis during class time and more formally, for example, in individual learning centres run by the School of General Studies for English and Maths instruction. New South Wales TAFE institutions have not implemented individualized systems of instruction that have been designed for whole courses. These systems feature division of work into short units, use of "learning activity packages", individual work at student's own rate and formative testing for student mastery of each unit of work. Some of these curriculum strategies have been implemented in some courses but no total system has been designed or implemented.

New South Wales is at present examining the feasibility and desirability of an individualized program in programmable controllers. Secretarial Studies is also seen as potentially one area that may benefit from individualizing, to cope with the range of background of students and to better provide for slower students who need more time. A lecturer in the School of Mechanical Engineering at Granville College of TAFE is preparing a report on the requirements of industry for training in programmable controllers and the suitability of providing this training using a computer-managed, competency-based individualized program. The lecturer involved, whose field of interest is fluid power, had observed and been impressed by competency-based individualized programs in fluid power in operation in North America. These are self-paced programs where students typically worked in pairs using individualized learning resources. Advantages of these operational North American programs were observed to be:

- high student interest
- wholehearted acceptance of the program by industry
- instruction directly related to industry
- employers very happy with the quality of students.

The lecturer concerned selected programmable controllers as the area to examine because:

- it is a new, rapidly growing area
- it cuts across a number of engineering areas and a number of industries (eg. milk factories, car factories)
- it penetrates deeply into the fluid power field
- it could be established in one centre serving a number of schools and a number of colleges.

Potential problems were seen to be the necessity to formally establish and support a completely different approach to handling student records, and the very slow centralized development of resources. The centralized system in New South Wales could be seen as making it more difficult to change teaching methods and course delivery procedures, especially if new programs cannot be trialled in one college or implemented college by college. The teacher time allocation system and the accounting system in New South Wales are rigid. Pooling of duties and staff establishments

is difficult or impossible. And the promotion structure exists on the basis of courses. All these factors mitigate against the establishment of individualized systems of instruction, where typically teachers are allocated to workspaces rather than to classes and can control computerized student records.

Major curriculum revisions in NSW, as elsewhere, have resulted in the implementation of modular trade courses, where the curriculum is divided into self-contained units based on topics or competencies. A major evaluation of modular trade courses in NSW has recently been conducted (Pearson et al., 1984). The relevance of the evaluation for this report is twofold. Firstly, the evaluation focuses on what has actually been implemented and experienced in modular trade courses. The characteristics, the strengths and the difficulties have been documented. This provides a basis from which to examine implementation of individualized trade courses. Secondly, the evaluation reveals that most of the strengths resulting from the change to a modular course structure are due to curriculum innovations independent of modularization. They could, in fact, have been introduced without making the course modular. The evaluation reveals that many of the difficulties experienced as a result of the change, however, appear to arise from combining a modular course structure with group-based instruction. The difficulties could be lessened by supplementing group instruction with systems of individualized instruction, even if not moving totally to an individualized course. Thus, the evaluation has documented some of the pressures that led to the development of individualized trade courses elsewhere. Highlights of the evaluation results are sketched below, and interested readers are referred to the evaluation report for fuller documentation and discussion.

Because implementation of modular trade courses in NSW is as yet incomplete and is continuing, the evaluation focused on five trade areas that have had most experience with modular courses. The trades were: Automotive Mechanics, Carpentry and Joinery, Commercial Cookery, Plumbing, and Horticulture trades. Modularization typically has meant restructuring the three years of separate theoretical and practical instruction into 24 modules averaging 32 hours each and

featuring integration of practice and theory. Modules can be readily updated, deleted or new modules developed in response to changes in technology or industry. In theory, modules can be combined in personalized course packages to suit individual student or industry needs, although constraints may be introduced such as setting prerequisites, or establishing core and elective units.

The evaluators confirm that the change to the modular course structure was accompanied by beneficial outcomes. These included a large degree of integration of practice and theory, change to a public and explicit course content, and more uniform teaching and student assessment across teachers and colleges. Continuous assessment has been introduced but mastery learning has not. The modular structure has made easier the ongoing updating of courses, and to a very limited degree has been used to improve access. Modular structure was utilised by colleges who varied sequence to suit local conditions, although students were presented with a fixed sequence of modules. Teachers of modular trade courses were generally enthusiastic about the new courses even though the courses were seen as making more demands on teachers.

The evaluators point out that non-modular courses in NSW that have been revised in the last decade have also achieved a large degree of integration of theory and practice. Modularization is therefore not essential for integration. Public, explicit course content and more uniform teaching and assessment has also largely been accomplished by specifying behavioural objectives with performance requirements. These curriculum aspects are independent of modularization.

The evaluators note:

The most striking instructional feature of the modular courses studied is that they have all retained group based teacher paced instruction...In the modular courses studied there has been no use of individualized learning systems which allow individual students to vary the pace of their progress and the sequence in which they complete the modules. These systems are generally thought by most trade teachers to be

inappropriate to the abilities of most trade students.
(Pearson et al., 1984, p 62)

The evaluators felt that lack of systematic individualized instruction in NSW arose from both choice and a lack of resource support for the innovation. Where there has been resource development conducted concurrently with modularization, it has been directed towards assisting group-based instruction and has not been systematically designed for individual student use, although the evaluators felt that some of it could be used for this purpose. The evaluators noted that there had been a great deal of informal individual teaching, however:

For practical sessions, teachers see themselves as involved in a great deal of individual tuition which is in part an outcome of there being less demonstration and more hands-on student activity. It is in these sessions that teachers can also assist slower students with help and the theory needed for the task at hand.
(Pearson et al., 1984, p 39)

There have been ever increasing pressures in trade training to increase the amount of hands-on practice, to shift from models to full scale materials and projects, to perform the practical work rather than just watch demonstrations. The evaluators note that the teaching of practical work and the integrating of theory and practice consequently becomes more difficult:

The emergence of synchronization as an important issue in all courses studied has created problems in the teaching of practical work. Either equipment needs to be provided for the whole class to perform the practical exercises at virtually the same time, or practical work has to be staggered or rotated. Where the latter option is used, synchronization suffers.
(Pearson et al., 1984, p 65)

Integration combined with group-based instruction has created equipment problems for trades that require many specialized expensive machines, and also for trades that require continuous updating to keep pace with changing technology. Mass purchase of such equipment for a whole class to use for a fraction of the course is obviously a

waste of resources, but rotation of practical work results in theory sometimes being taught months earlier. At least one school in NSW (Fitting and Machinery) is considering the development of learning packages for individual use to repeat and supplement earlier group instruction.

The evaluation also revealed that unique features of modular trade courses have not been taken advantage of in NSW, partly because of group teaching of intact, relatively homogeneous classes. Modularization has not led to flexible entry and exit. Modular courses have not been used to combine different types of students. The development of elective modules for student specialization has been inhibited, and students are not offered a choice of module sequence that may better suit their employment situation. Modular course structures mean that each student should pass each module and each prerequisite before progressing to further work. Students who fail modules and need repeat instruction cause obvious problems where courses are based on group progression.

Difficulties experienced in New South Wales TAFE as a result of modularization of skills-based courses while retaining group-based instruction and progression, include:

1. Difficulties in achieving integration of theory and practice where either the same materials and equipment had to be provided for everyone in the class simultaneously, or if practical work is rotated, difficulties in rotating theory instruction.
2. Difficulties in maintaining integration of theory and practice for individual class groupings where the college tradition was separate theory rooms and practice rooms.
3. Underutilization of the unique features of modular trade courses for enabling flexible entry and exit and for allowing student/employer choice of module selection and module sequence.

No major difficulties were experienced with student achievement or student attitudes.

The evaluation's main recommendation is that:

Modular course structures be seen as an appropriate option for trade course design in NSW Department of Technical and Further Education. Special efforts should be directed towards those features of course design that allow students/employers some choice in attendance patterns, module sequence and course specialization.

(Pearson et al., 1984 p vi)

The potential of modular courses for meeting student and employer needs can more readily be utilized by supplementing group instruction with individualized instruction. This would also assist continued upgrading of practical instruction and flexible use of equipment. The evaluators feel that:

The step to a greater degree of individualizing instruction to allow further flexibility in student access, progression and flexible use of equipment would not be a major one in some trades.

(Pearson et al., 1984., p v)

This step has yet to be taken in New South Wales.

3.2 Victoria

The Victorian TAFE system pioneered the introduction of self-paced trade programs in Australia in 1975, and they have proliferated since. Victorian initiatives in self-paced learning were paralleled by the introduction of other initiatives such as modularization of courses, accelerated apprenticeship schemes ("front end" training), and the introduction of the Instructional Systems Model for course development. Most of these initiatives were attempts to make more effective the off-the-job training of apprentices, to increase their productivity, and to make them more productive earlier. A wide range of approaches to apprenticeship training now exists in Victoria.

Individualized systems of instruction have been implemented in a number of areas in Victoria including panelbeating, plumbing, bricklaying, carpentry and joinery, sheetmetal, woolclassing, horticulture, and fitting and machining. Other areas, e.g. electronics and mathematics, are

developing materials that can support individualized learning. Most of the materials and resources development in Victoria was done by teachers in their preparation time or under time release, rather than centrally. Some of the implemented courses are aided by Computer-Managed Learning programs. Some Computer-Assisted Instruction has been introduced such as PLATO or MICROPLATO programs for remediation in basic reading and maths.

Implementation of these individualized courses has been accompanied by a plethora of reports. These include:

Griffin, P. and Izard, J. (1978) Accelerated Apprenticeship Training Evaluation Study 1977/78 Report No.1.

MacDonald, C. (1980) Individualized Instruction in Vocational Education.

MacDonald, C. (1980) Evaluation of Self-Paced Learning in the Panel-Beating Department, Richmond Technical College.

Bell, M. (1982) Problem-Solving and Portrayal Evaluation of Woolclassing Self-Paced Materials.

Thompson, J. (1982) Evaluation of Carpentry and Joinery Broad Stream Training Program: Full Time Basic Training Stage.

Thompson, J. (1982) Evaluation of Carpentry and Joinery Broad Stream Training Program: Apprentice Performance and Subsequent Training Year One.

Curwood, M., Clifford, B. and Murby, J. (1982) Statewide Development of Computer-Managed Learning and Computer-Assisted Instruction.

Hayes, R., and O'Sullivan, J. (1982) The Impact of PLATO as a TAFE Learning System.

Bell, M. (1985) Implementation of Self-Paced Learning in TAFE.

Elsworth, G., Gilding, T., and Hall, K. (1984) Computer-Managed Learning in Technical and Further Education: An evaluation report.

Individualized trade instruction in Victoria tends to have the following characteristics:

- performance-based self-paced units of 8-10 hours
- theory presented first in the resource room via a written workbook ("flip book") and/or video together with objectives and study guide
- theory learning assessed by a short written test
- practical work attempted in the workshop on full scale task using the workbook for instructions
- performance assessed by a checklist specifying standards to be reached
- unit mastery requirement with "recycling" through the same instructional materials.

The courses have similarities to Keller's Personalized System of Instruction (Macdonald (b), 1980, p 6) and share features such as provision of objectives and unit mastery requirements. There are important differences however. First, information presentation differs. In the traditional PSI program of almost 20 years ago, there was complete reliance on written material, often traditional textbooks. The Victorian model uses Learning Activity Packages which are, in effect, units of Programmed Instruction using multimedia presentation where possible for information presentation. Secondly, individualized systems of instruction in Victoria have been developed according to the Instructional Systems Model for Vocational Education. This model as used in Victoria is an interactive systems approach to curriculum development that features job and task analysis, course design, course implementation, program evaluation and on-the-job validation. The Instructional Systems Model used in Victoria resembles the ISD model developed for military technical training (Section 2.7).

Self-pacing or individualization according to pace, is the most obvious characteristic of individualized systems of instruction in Victoria. Some trade areas use this to facilitate open entry-open exit. Other trade areas are now beginning to produce new syllabuses where individualization can also be by module sequence.

The variety of approaches used to deliver individualized instruction in Victoria can be gleaned from the following summary of a sample of the programs in operation. Each program is not described in detail. Instead, the similarities among the courses have been assumed and are

summarized above. The descriptions below focus on differences between the course being described and those described previous to it. This highlights the range of individualized courses in operation.

Program: Panelbeating

College: Richmond College of TAFE (in operation since 1975)

The course consists of 24 modules divided into smaller units each based on a performance objective. Units are completed one at a time at the students' own pace and students may move from one module to another although most progress through one module at a time.

Students can enrol at any time during the year. They are centred on one of four work areas set up for groups of modules each staffed by one teacher. This provides for peer interaction and support. There is free movement of students between the resource room and workroom. There is a high degree of use of audio-visual materials. Alternative sets of resources for the same course material have been developed using different media. The tasks are designed so that the student has to figure out what to do. Mastery is required for progression - multiple versions of theory and practical tests are available via the college computer. Work must be passed to a predetermined mastery level with criterion-referenced testing used. Some problems were experienced initially with specification and enforcement of standards and the concept of mastery.

Computer-Managed Learning (CML) and progress charts are used for record keeping and management. Richmond have developed their own CML package (using an IBM-PC) for management purposes. It cannot be used as a large test bank but it gives additional management information regarding cumulative student progress through modules and units not provided by other CML programs used in Victoria, e.g. Computer-Based Training Systems (CBTS).

There is a recommended module sequence but this can be varied to suit the availability of equipment. The first sixteen modules are set, then the employer selects the remaining eight. The program features open entry and exit, and a variety of students can be accommodated at the one

time - block release, out of trade, link students, short courses, etc. Richmond used to put about 180 students through a year (70+60+50 students for years 1+2+3) and now hold at 210 students constantly.

The Richmond program has changed and evolved over time, for instance, a recent innovation is the decentralization of administration functions. Richmond has changed their staff structure to assist the smooth running of their program - they have redefined, reallocated and decentralized administration tasks. They now allocate people to functions in each of the three stages. Functions are according to responsibility for Administration (student records, employer liaison), Curriculum (support materials, inservice activities), or Resources (materials, equipment) plus a facilities room supervisor and a live work coordinator. This makes for a total of 11 decentralized administration functions. Teachers fulfill their function in their previous preparation time.

An evaluation conducted in 1979 concluded that self-pacing in Panelbeating at Richmond was an effective teaching strategy, particularly as it allows for variation in learning rate, it accommodates literacy problems through use of audio-visual media, it allows for free movement of students between practice and theory areas, it fosters high levels of student motivation and satisfaction with the course, it develops a high job satisfaction among staff/ reduces student discipline problems and improves staff student relationships. The main area of difficulty (in 1979) concerned specification and maintenance of standards, the design of the learning programs and the changed role of the instructors. The need for staff training in the operation of a self-paced program was stressed. Staff development has been a continuing process at Richmond, resulting in gradual evolution from "trade instructor" to "educators".

Program: Bricklaying
College: Preston

Preston first introduced a self-paced bricklaying program in 1976 and since then have produced a new series of learning packs and a new syllabus with increased practical content.

The course is performance-based, featuring mastery learning based on numerical marks (80% pass written 50% for practical).

The course consists of 24 basic modules done sequentially - and there are 3 or 4 advanced modules that can be substituted with permission. It is based on workbooks, one per module, although they are now considering breaking modules up into smaller units of work each with separate books.

Although this is an individualized system of instruction, the self-pacing aspect is not stressed. It is useful, as the entry skills of students are very different, but it is considered that "self-paced" relies too much on students. Also, students must complete 960 hours, laid down by ITC ruling, so there is no open entry-open exit system.

Group instruction is used for theory classes at the beginning of each two week block of release. Practical tasks are based on solving problems. Work is redone if not up to the standard. Workbooks are read out loud for students with learning difficulties.

Faster students can do extra, advanced modules or start a builders' technicians course. Slower students can work one night a week or take longer than the 960 hours, for which employers don't have to pay them. The content and timing of modules is such, however, that the majority of apprentices finish during week 24 (10% may finish early). The introduction of self-pacing to preapprenticeship programs is being considered but at the moment the different types of students are not being mixed together.

All six colleges offering bricklaying in Victoria are now self-paced using the same learning packs and implemented much the same way in each college. Students can readily move from one college to another.

Program: Plumbing
College: Box Hill

Plumbing stage 2 (650 hours) is the prototype of the individualized program where instruction is individualized

not only within modules but also completely individualized by the sequencing of modules the student takes.

- Stage 1 - (six weeks' training over six months) is group-taught teacher-centered
- Stage 2 - comprises 50 stand alone units accompanied by learning packs - students do all 50 on an individual basis not in a set sequence, slower students are catered for by evening school and become a journeyman's tradesman
- Stage 3 - advanced phase - students specialize in one of five areas for six months to become a licensed plumber. Group-taught teacher centered classes.

In stage 2, Computer-Managed Learning (CBTS) is used for record keeping and as a test bank for student evaluation and diagnosis. CML facilitates the flow of students through modules and relieves the management load so only one or two workstations for the 50 or so installations required need be built. The program is performance-based using checklists and standards, graded pass or fail.

A management facilities chart is used to monitor facilities use and student progress and help direct students to the next unit. CML is used very readily by students. Test item banks can assess higher levels of questioning by referring students to an illustrated book of diagrams. CML also produces all of the checklists necessary for the performance testing.

Program: Carpentry and Joinery
College: Newport College of TAFE

The program is proficiency-based, and was developed on the basis of a detailed trade task analysis. It is characterized by a practical orientation, including on-site components with trade knowledge integrated with the work unit. Training objectives are specified for each trade task in performance terms and student achievement on each task is assessed either Pass or Not Complete according to prespecified standards. Students reattempt each objective until they reach that standard. The program was developed to be consistent with the Instructional System Model for Vocational Education.

Teaching strategies focus on prepared student packs which are designed for self-pacing and for individual student consultation with the instructor regarding progress at frequent checkpoints. Self-pacing is limited by specifying the number of units to be completed in a set time, and by the requirement for group work on full size projects. Slide/tape programs, flip cards, and oral testing are also used. Extensive curriculum development to support program implementation took place.

The initial 12 week college-based program is designed to develop basic hand tool skills, basic site skills and trade vocabulary prior to commencing work. Students progress through units in a set order, with a choice of housing or industrial strands. The subsequent training, comprising 12 one-week blocks, is designed to provide the employer with a range of elective training units in industrial and house construction areas. The training units are of variable duration (0.5 to 7 days) and designed as discrete units of work. From a possible 50 training units totalling 105 days of college-based training, the employer selects 60 days for the apprentices, appropriate to their on-site work requirement. For the elective training, no two apprentices' programs were identical. This makes the program administratively complex.

An evaluation conducted in 1982 indicated that the program achieved its main goal of making apprentices more productive earlier in their apprenticeship. Student and employer attitudes were very positive. A need for an orientation program for students and ongoing staff development programs was indicated.

In some colleges Carpentry and Joinery offers rolling enrolments of a minimum of two students if space is available. Other colleges with large enrolments use group-pacing to ease the strain on the use of facilities.

Program: Horticulture

College: Oakleigh Technical School

The course consists of 24 modules supported by workbooks containing practical work. Students do 3 or 4 modules in

parallel, individually assisted by a tutor system. Self-pacing is modified as students are paced by deadlines for tests.

Real life work is introduced through a sales centre, a landscaping service and a public horticulture advice service.

Program: Sheetmetal

College: Richmond College of TAFE

The program is similar to panelbeating though without the division of workshop into distinct work areas. Computer-Managed Learning (CBTS) is used mainly as a test item bank for theory work only, for only some of the units.

Program: Woolclassing

College: College of Textiles

Self-paced materials have been developed for use in the woolclassing certificate and are being used in both self-paced mode and as a learning resource in a group-taught mode.

Program: Mathematics for Electronic Engineering

College: Box Hill College of TAFE

This is a well structured subject based on modules; each module has up to nine objectives. As a result of participation in the Computer-Managed Learning project (see below), self contained individualized instruction workbooks have been produced and test item banks established. Diagnostic assessment with students entering the course at the appropriate level is now possible although so far the course has been taught "lock step".

Computer Managed Learning

Four trade areas (plumbing, electrical, sheetmetal and fitting and machining) and a maths service course have been trialling a particular Computer-Managed Learning System called CBTS (Computer-Based Training Systems) which is machine dependent on VAX computers. This has the potential to relieve the management and record keeping load associated

with individualized instruction.

The trial demonstrated that CML via CBTS is a useful aid in individualized trade courses, especially where unit or module sequence as well as rate of progress was variable, such as plumbing stage 2. Courses that were not individualized (maths and electrical were taught "lock step" but they are developing course material to support individualized learning systems) tended to use the program solely as a test item bank. CBTS was not user friendly for instructors or the course managers, though it was user friendly for the students. CBTS is not a flexible system. A need was identified for staff support in developing course material, writing objectives and test times.

3.3 South Australia

As in other educational systems, there is a history of individual teaching of one form or another in the South Australian TAFE system.

Adelaide College commits substantial resources to distance education, and external studies programs are available in a variety of fields including small business, computing, adult literacy, general studies, migrant and Aboriginal education. Most of these follow traditional external studies models and are not based on individualized systems of instruction. A wide range of learning materials has been prepared for these courses. The older materials were used only for distance education but the newer multipurpose teaching packages are used extensively in classrooms and in remedial work as well as in the distance mode, and they are used for a variety of student populations. It is possible that some of these materials could readily be adapted for use in college-based individualized instruction programs. It is, however difficult to offer individualized systems of instruction as such on a distance basis because of the need for continuous assessment and frequent feedback.

The South Australian TAFE system is also becoming involved in using computers in teaching and learning, particularly Computer-Assisted Instruction for the adult literacy unit as a supplement to the standard form of literacy tutoring.

Individualized systems of instruction have been implemented in the South Australian TAFE system. Croydon Park College of TAFE has competency-based individualized programs in Panelbeating and Sheetmetal, and Regency Park Community College of TAFE has one in Refrigeration and Airconditioning, and is in the process of developing one for Butchery. Other trades such as Horticulture are also examining the feasibility of such programs.

Program: Panelbeating

College: Croydon Park College of TAFE

The Panelbeating staff at Croydon Park had, through the biannual conferences, been aware of what Richmond College in Victoria was doing in regard to a self-paced Panelbeating program. They were encouraged to develop and implement their own competency-based individualized program partly by the following factors:

- . very positive student attitudes noted at Richmond
- . positive staff attitudes observed among Richmond instructors
- . appealing notion of "standard is uniform, time is flexible", and turning out to industry an end product that is fairly uniform
- . a major curriculum review was about to begin, and coincided with Richmond being ready to sell the material they had developed
- . support from educators at the South Australian College of Advanced Education for the concept of competency-based vocational training and assistance from them with staff development, design and evaluation.

A major evaluation of this program will soon be completed (Competency-based vocational education: An evaluation by Harris, Barnes, Haines and Hobart, 1984) and a detailed staff development package has been prepared by a member of the evaluation team and is now available through the TAFE clearinghouse system (Barnes, 1984).

Competency-based vocational education (CBVE) may or may not involve individualized instruction. Essential characteristics of CBVE (Harris, 1984, p 6) are:

1. Competencies to be achieved by the students have been:

- a carefully identified
 - b verified by local experts
 - c made public
2. Criteria for assessing each of the verified competencies have been:
 - a derived from analysis of the competencies
 - b explicitly stated along with conditions
 - c made public
 3. Instructional program provides for the:
 - a individual development of each competency
 - b individual assessment of each competency
 4. Assessment of the students' competency:
 - a takes knowledge into account
 - b takes attitudes into account
 - c requires actual performance of the competency as the major source of evidence
 5. Students progress through the program:
 - a at their own rate
 - b by demonstrating their competence

Desirable but not essential features of CBVE include:

6. Instruction is individualized to the maximum extent possible
7. Learning experiences are guided by frequent feedback
8. Emphasis is upon student's achievement of exit requirements
9. Instruction is individually paced rather than time-based
10. Instruction is field-centered using realistic work situations and actual on-the-job experiences
11. Instructional materials are:
 - a modularized
 - b mediated
 - c flexible with both required and optional learning activities provided
12. Instructional program as a whole is carefully planned and systematic - evaluation data is used for program

improvement.

The program at Croydon Park features many of the essential and desirable features of competency-based vocational education listed above. Note that frequent feedback and individualized instruction materials are considered as desirable rather than essential features of CBVE whereas these are essential elements of PSI.

The program at Croydon Park was introduced at the first year level in April 1983, subsequent to extensive staff inservice programs in November and December 1982 and resource development early in 1983. The program has been extended and in 1984 second and first year students were self-paced.

The curriculum was divided into 20 broad categories and competency statements developed for each category. The competencies are all in the psychomotor domain. Learning packages were developed for each competency, and consist of:

1. student guide containing introduction, performance objective, pretest, prerequisites, learning activities and resources, student response sheets and performance checklist.
2. information booklet, both written information and photographs, containing all the knowledge students need for mastery of the particular competency. Often supplemented with slide/tape sequences, in which case the text of the tape is also in the information booklet.
3. answer sheets corresponding to student response sheets.
4. audio-visual and supplementary written resources.

Instruction is individualized and self-paced, and as much audio-visual material as possible was developed or adapted for use. Actual performance is evaluated by assessing the product against a checklist.

Advantages of the program and the way it was introduced are seen as including:

1. Students going through the course have to achieve the desired skill. Before - some students did the job others were spectators.

2. Flexibility of speed is seen as a mixed blessing. The better student isn't held back - a student who has had experience on part of a job can proceed quickly. The spread of competencies after 8 weeks was a problem. Top student had completed 46, bottom student 23.
3. Once the learning resources are all prepared, the amount of traditional preparation and marking is decreased. Still must keep packages up to date, and change as problems become apparent. Can spend more time in getting material ready for the students.
4. Regarding costs, they may be using more material (steel, oxy acetylene gas etc) but require less multiples of major equipment (e.g. MIG welder) - instead of 10, now only 1 or 2.
5. Apprentices need to be able to recognize the quality of their work. This program leads them into being able to assess their own work.
6. Employers were very impressed.
7. Students who miss a week can come in any other week to finish.
8. Minimal staff problems.
9. Flexible intake is in operation - they take a student at any time if there is room - keeps staff/student ratio up. Staggered intake works better as they don't have to show 10 people at once how to use the equipment and have 10 copies of the packages for early units.

Disadvantages and problems experienced included:

1. Preparation of material was only hours ahead of students and created extra workload. They didn't start second year till halfway through first term, and slowed them down in first year. They experienced great pressure in trying to keep up with the students in production of material. A media type person is now seen as essential. If they did it again they would start with third year students and work backwards producing material - also if it is not successful it is easier to drop it - difficult to change first years over to a conventional program now as they are all at different stages.

2. Course was very closely scrutinized - they opened themselves up for criticism - once a fortnight meeting to examine what they're doing - going through lesson by lesson on fortnightly basis. Looked at forthcoming modules and cut out overlap and examined content - some first year modules shifted to second year, etc. Fortnightly meetings came up with those solutions. Need to focus meetings on constructive suggestions.
3. Set 50 units for first year but students only got through 30 or so - set too high a criteria on the units (credit standard became pass standard). This retarded progress of some students, e.g. welding had third year standards for the first year students. Criteria levels were adjusted (thus the "standard is inflexible, time is flexible" idea was modified).
4. Some students slacked, some didn't want to repeat work. There is a problem of slow students not getting through the work in 800 hours. A few are coming in at night. They feel they stressed self-pacing too much for the first intake, students were very slow. For the second intake staff downplayed self-pacing, and set a rate of completion of one competency per day (on average). Students progressed much more rapidly.
5. Records clerk had some difficulty with differing units being completed by different students.
6. Teachers are not always sure what each student is doing each minute of the day.

The program evaluation conducted by Harris et al. (1984) confirms the success of the program. Students enjoyed the method of learning and found the approach interesting. Teachers noted increases in student performance, and teachers and employers judged the program to be more effective than the previous traditional program. It fostered more personal satisfaction with teaching. Difficulties centered on staff role, materials revision and teaching facilities.

The evaluation focused on the adequacy of the program in adhering to the principles of competency-based vocational education. This system is very well suited to a practical

trade with hand skills. Recommendations developed include incorporating more affective criteria in the materials and performance checklist, developing some form of testing of knowledge to consolidate student learning in different areas, and making cognitive questions more challenging in terms of taxonomic levels. There was some evidence that staff varied in their marking and interpretation of performance criteria and in approaches to "recycling" when criteria are not achieved.

The evaluation also revealed that a few students required constant monitoring and guidance, and some immature students had used the system to "go slow". Staff experienced supervision problems and had reservations about less able or less mature students. Teachers were concerned about student motivation, students themselves indicated there is opportunity to "slack off". Two main areas for improvement are seen as:

1. Increased coordination in the learning materials, and
2. Tighter supervision on the part of teachers in their helping, encouraging and motivating roles as resource persons (Harris et al., 1984, p 150).

Other observations include:

1. Students get very reliant on the booklets - instructors try to persuade them to use their own resources more
2. Some supervision problems were experienced - fibreglass is in a separate room. Safety problems rather than behavioural
3. Students group up and work together, student self help develops
4. Videos are less troublesome than slide/tapes where the machines break down. They are transferring their slide/tape programs to video
5. Suits overcrowded areas - students can do the work one at a time - before 10 students and 4 windscreens - they all didn't do the job. Now you are sure they all do it. Suits smaller programs also as you can combine them
6. The role of the lecturer was markedly different -

regular fortnightly discussions aided the smooth run of the program.

For others thinking of introducing this type of program they suggest:

1. Go through prior staff development program
2. Present system here not administration imposed very easily sabotaged if not all in favour
3. Start at end of course and work towards front
4. Build on work of others as much as possible.

Program: Refrigeration and Airconditioning
College: Regency Park Community College of TAFE

This College has recently implemented a self-paced program with six months lead time. Students were first enrolled April 1984. The change was from a topic-based group-paced course with a written final exam to a performance-objective based program with some degree of individual progression and emphasis on practical work.

They have deviated from the model followed by Panelbeating at Croydon partly for the following stated reasons:

1. Panelbeating has a very small theoretical component. Refrigeration and Airconditioning has a large theoretical base.
2. Panelbeating comprises largely psychomotor skills. Refrigeration and Airconditioning are often troubleshooting and need problem solving competencies. Troubleshooting is built in toward the end of some units.
3. Refrigeration and Airconditioning needs to assess the process - Panelbeating concentrates on the product.
4. Panelbeating is a narrow trade - Refrigeration and Airconditioning is a broad, very diverse trade. To keep training broad, Refrigeration and Airconditioning had to dilute competencies.
5. For some modules students are brought back together and group-taught at the end. Customer relations is also

done as a group. Altogether, group work may occupy 10-20% of the time.

Regency Park established each module to correspond to two weeks' work for the two weeks' block release. All students work on the one module. This was done partly to reduce administration problems, and also because the resources needed to set up a module are fairly extensive and based in 5 workshops not just one. They modularized it to use one room at a time. Thus, they do not have open entry and exit. There are 7 or 8 competencies in each module and teachers attempt to make sure that students finish those by the end of the two-week period. Each competency gives students several different types of things to do and each competency is assessed in 3 or 4 different ways. Also, within one module there may be 4 parallel streams going at once. Students can challenge and do the tests without going through the work. Problems were experienced with self-pacing - the students had no incentive for completing the work faster. Teachers have introduced a credit rating for students who finish early and then complete additional work. This acts as a buffer for pacing the group, plus some employers give financial incentives for students who do better. Teachers felt they had a legal responsibility for the apprentices for 880 hours. Adults can finish a 12 week course in eight weeks but apprentices can't. So rather than finish early, they finish at a higher level of proficiency. Apprentice classes are topped up with adult learners to maintain group size. The program is run day and night. Day students who are slow can come back at night.

Perceived advantages of the course include assessing and recording exactly what the student knows. Problems were experienced in setting criteria levels and in setting and using standards for the department rather than individual standards.

The staff feel it would be hard to force this type of program on a department or lecturer. It should be looked at as an option, as part of a curriculum review, but they feel it is a lot of work and it is more demanding on the staff.

For anyone else thinking of this type of program, they suggest examining:

- production and availability of material
- type of courses
- physical resources

3.4 Western Australia

As a result of curriculum development processes in Western Australia, a number of TAFE study areas are currently modularizing and developing stand-alone units of work featuring integration of theory and practice. As part of this process, "self-paced" learning is being examined as a potential teaching strategy and as a basis for materials development.

Successful "self-paced" programs implemented in Western Australia include Panelbeating and Spray Painting. Commercial Studies are developing and piloting individualized materials, and an individualized unit on Care of the Newborn has been successfully implemented as part of the Child Care Certificate Course. Reports produced include three review papers and one program evaluation:

Locke, T. (1981) The Implementation of Mastery Learning and Individualized Instruction in Technical Education

Locke, T. (1981) Mastery learning and Individualized Instruction

McDonald, T. (1982) Modules: Self-Paced Learning: Mastery Learning: Competency Profiling

Camaren, R. J., Swain, M. & Jongeling, S. (1983) Self-Paced Instruction in Panel Beating and Spray Painting Apprentice Training: An Evaluation of a Pilot Project.

Course: Secretarial Studies

Commercial Studies in Western Australia has been developing self-pacing audio-tutorial materials in typing, audio, stenography and typing speed. The audio materials were piloted in three Colleges (Leederville, Perth and Rockingham) in 1984 and are still in use. Modules in other areas are not yet complete but there will be a full pilot

course in 1986 in Thornlie College.

Self-pacing is being introduced by Commercial Studies to achieve certain objectives. Advantages are seen as:

1. It is competency-based
2. It can cope with a wide spectrum of entrants, e.g. 4th year business, Yr 10 regular, mature age, teachers, those interested in high technology only, and distance education students
3. It can cope with staggered entry and exit (students leave when they get jobs)
4. It may help to overcome high failure rate.

The course is structured around five modules - business letters, memos, tables, figures, and company typing. Each module has three parts and is of 2-3 months' duration. Students can do part 1 of each, then part 2, then part 3 i.e. cycle through. "Production assignments" are used to help integration and recall.

Electives are possible but remain as college choice not student choice. "Self-paced" in this program involves timetabling the resources rather than the student. Resources can be used for a number of modules which opens up options for the students. Some teacher-pacing is used in stage 1. Students take 6-8 weeks to settle in and are taught how to self-pace rather than being taught the subject. Group presentation is used for 1) introduction to shorthand theory, as they can pace students through more quickly, and 2) interpersonal relations, where interaction is important. A small pilot of audio-typing revealed that many students did not reach the criteria of "mailable copy" due to lack of prerequisites of speed and spelling.

"Pastoral care" is seen as important for individualized instruction - taking a personal interest in students and their progress and not just leaving students on their own. Secretarial Studies are moving to "open plan" with students working together on projects.

Course: Care of the Newborn

At Perth Technical College an individualized instruction

unit has been developed in Care of the Newborn, an area involving learning many new skills, and a popular area for inservices. The unit, of 2 hours per week for 18 weeks, is comprised of 35 core topics, each having between 1 and 6 performance objectives. The unit is coupled with practical placement in a maternity hospital postnatal nursery for a minimum of 20 days after completion of the first 20 topics.

Many TAFE individualized programs involve assessing a specific student product using a checklist. In Care of the Newborn the procedures and methods used must be assessed rather than the product (eg in mixing infant formula). Checklists are used while watching the procedure followed by the student. Students are taught the correct procedures using self-paced instructional packages and utilizing videos and slide/tape programs and coloured flip books. They practice testing each other. There are time limits set, but within the time limits students can select which performance objectives to spend more time on. One slide/tape program attempts to get certain values across, e.g. talking to the baby as if to an honoured guest, and students are assessed on attitudes in the field. There is one teacher to ten students. Teachers feel it is much more exacting than regular teaching, and that they are really pushed to the limit, as they have to assess one student while scanning the rest.

Self-paced packages weren't developed for all topics. For instance, a lecture is given on natural feeding, as breaking the topic up into small units was difficult. Other topics, for instance, baby clothing, were judged to be not worth the time involved either in preparing the self-instructional materials or in student reading through the materials. To lecture for some topics is a more economical use of time for both teacher and student.

Group discussions are used to check learning and attitudes, and lecturers and discussions are used both to instil a non-judgemental approach to patients and to deal with emotive topics such as Sudden Infant Death Syndrome. Some slide/tape programs are shown to students as a group especially where there is a need to answer questions and add information.

Students like the individualized program - they like being in control. The more mature students are, the more comfortable they are with it, e.g. those that have been out working think it's great. The ones straight from school are tense at first and need a little support, help and guidance. They are given some of the quick packages first to help them get the idea.

Developing the self-paced materials took enormous amounts of time. A technician was provided but was inexperienced. Borrowed equipment was used and technical quality was poor. Now there is no time to modify the materials. Need a lot of skills in addition to being keen on the concept - need to know how to work out scripts, how to present material visually, how to edit.

Courses: Panelbeating and Spray Painting
College: Carine Technical College

Western Australian initiatives in self-paced learning in Panelbeating and Spray Painting have followed Victorian initiatives in these areas. They began with stage 3 apprentices in 1982 at Carine Technical College and expanded into stages 1 and 2 of training in 1983.

The program is based on performance objectives derived from task analysis, and is in modules of 40 hours with theory and practical integrated. Panelbeating used 20% of materials from Richmond, while Spray Painting was entirely developed locally. Teachers started producing resources for the end of the program, as they realised they couldn't produce programs at the speed students required them. Also stage 3 students are soon out on the job, talking to employers and prospective employers about the program.

Individualized instruction was used because it:

- . motivates students
- . keeps them in the workshop
- . keeps teachers involved
- . industry likes it
- . allows flexible entry and exit
- . results in faster progression
- . doesn't allow those in trouble to sit quietly at the back of the class

- . assessment is on ability to do practical component, not on academic skills
- . allows for flexible entry. They combine 3 stages in 1 group. There is no early exit. Fast students are on advanced programs and slower students given smaller jobs
- . students can work on 3 or 4 modules at once
- . it is based on flip books containing theory and practical. They require 2 flip books per college - 7 per State, as against 100 text books which get out of date. Flip books can be readily updated.

They modify the individualized approach by teaming students up:

- in mixed classes, junior boys can be put in with older boys for bigger jobs
- for communication techniques, students work in pairs roleplaying (apprentice and client)
- to teach skills that don't lend themselves to a traditional classroom e.g. phone skills, tape phone calls and listen to it, and
- for industrial trends program on new products.

They feel implementation puts teachers under a bit of pressure:

1. Students are not doing the same thing, teacher is always on the go, no captive audience.
2. Getting the right live work can be a problem (e.g. need 12 rocker panels replaced - previously just needed 1 for a demonstration).

Classes are mixed, with preapprentice and unemployed in together with apprentices. They use progress boards as a motivator for students. Slower students can come in when night time hobby classes are on. Preapprentices do stage 1. If the student gets a job, he only has to go to school for 2 years - an advantage for employers. It is a flexible program - can change from preapprentice to apprentice if they get a job after 6 months, etc. Yet preapprentices are unfamiliar with trade terms, and think they are still in school. They have no trade experience to back them up. They need orientation classes to explain the program - it

takes them a while to adjust. It takes some students a while to grasp it - the necessary vocabulary is not there, they are not sure how to go about it, not sure of standards.

An evaluation of the self-paced program revealed that the stage 3 apprentices, who had had traditional programs in stages 1 and 2, judged that the self-paced program was superior and preferable to the original mode. There was strong evidence that the self-paced program led to desirable affective outcomes as well as desirable cognitive and psychomotor outcomes. The evaluation report concluded that self-pacing improved the quality and quantity of instruction. The need for staff development was stressed.

3.5 Summary

This review of individualized courses, albeit brief and selected, gives an indication of the range and variety of courses that exist. Their successful development, implementation, and evaluation attest to the value of individualized instruction in TAFE. Programs which are carefully developed and have staff support provide an effective training system for skill acquisition and skill development.

4. DISCUSSION AND CONCLUSIONS

Individualized instruction is an innovation that is not clearly defined and has many variations in its methods of implementation. Section 3 gave an overview of the varieties of individualized programs in operation in TAFE in Australia. This section provides a descriptive analysis of the development and implementation of individualized programs in TAFE, their instructional features and educational outcomes. Conclusions drawn from this analysis and from the research literature summary in Section 2 will assist in determining the important variables and suggesting new options. The basis for this analysis and synthesis, then, is the empirical evidence available regarding what can and does take place, rather than what various theories say ought to take place.

4.1 Development and implementation of individualized programs

Problems and concerns about traditional TAFE courses have been voiced for decades. Industry changes render traditional courses irrelevant, to varying degrees, for industry needs. Industry pressure, government initiatives and teacher concern become forces for change. Relatively recent educational innovations also become a force for change, as does change in the ability and educational level of entering students.

Innovations in TAFE instruction that have been or are being introduced include:

- modular course design
- systems approach to instruction using behavioural objectives
- integration of theory and practice
- individualized instruction ("self-paced" learning)
- performance-based training
- project and full scale work
- competency profiling for both job and student
- continuous assessment and criterion-referenced assessment
- mastery learning

- use of a variety of educational media technology and resources.

The main revolution in TAFE training has been in practical training, in the amount of practical training undertaken and in integration of theory and practice. These changes have been most pronounced in the apprenticeship area, and it is in the apprenticeship area that most systems of individualized instruction in TAFE are to be found. Performance-based education and individualized instruction facilitate the systematizing of practical instruction and help ensure that individual students receive sufficient practical training. Those areas with an emphasis on the development of psychomotor skills (hand skills) are also those areas where systems of individualized instruction are to be found in TAFE.

Individualized programs successfully implemented in TAFE have for the most part been developed and implemented as a result of local staff initiative, often as a result of a major curriculum review that resulted in the concurrent introduction of a number of other curriculum innovations. In fact, sometimes "self-pacing" was promoted by central staff not as an end in itself but in the role of a change agent to facilitate the introduction of other desirable curriculum reforms noted above, and to increase the amount of practical training.

Individualized systems of instruction are sometimes seen as "teacher proof" ways of introducing desirable instructional design features. However, it appears to the contrary that individualized programs are very dependent on teachers. The implementation phase is very important. Departments that have introduced individualized programs successfully are relatively unusual. The staff have accepted a large role change (this has been particularly so for trade instructors) and implementation has often been accompanied by extensive outside assistance with staff development and training. Most of the program evaluations conducted stress the need for staff development and the need for staff to function as a team. Staff involved in successfully implemented programs emphasized the effects of the program on student attitude and performance, and that industry liked it.

The research on individualized instruction does not deal in a large way with success or difficulty of implementation, or with instructor reactions, but there are suggestions of problems in these areas. In self-paced programs, teachers have great difficulty regarding provision of extra learning time for the slow students, and management problems regarding provision of extra activities for the fast students (Arlin, 1984, p 74). Instructors find discussing the same topic repeatedly with different students boring and complain of too many administrative tasks and of being "glorified study hall monitors" (Thompson, 1980, p 371).

The results regarding the effective features of PSI also have important implementation implications. To many instructors, individualized instruction and self-paced instruction are equivalent. They fail to realize the importance of small steps, immediate feedback and the mastery requirement. In practice instructors often combine steps, delay feedback and relax the mastery requirement, yet feel they are providing effective individualized instruction solely because students are self-pacing. Actually students are not self-pacing, they are pacing according to the immediate contingencies, which often means slow-pacing. Procrastination can be a serious management problem in self-paced courses without early exit. Early exit is a strong motivator.

Individualized programs are resource intensive and the development time needed is enormous. It was suggested by some informants that difficulties which can lead to program failure may be experienced in both the development phase and the initial implementation phase. Such difficulties are encountered when there is:

- . insufficient allocation of resources
- . opposition of staff
- . imposition of the program on staff "from above "
- . inadequate training of staff
- . adoption of a very traditional outlook and approach by staff.

4.2 Instructional features and educational outcomes

Individualized programs in TAFE exhibit a variety of

approaches to instruction. Although most exhibit the features outlined earlier (p 26), they vary in design of workbooks and learning programs, use of alternative modes of presenting instruction, student assessment and progression procedures, use of CML, individualization by module sequence, open entry open exit, limitations on self-pacing, degree of group instruction or other instructional strategies used, and so on. Each department has introduced those features of individualized instruction that appeared appropriate to their needs.

Individualized programs facilitate a practical orientation and allow introduction of a unit mastery requirement based on student performance. These are its main strengths. It can improve student access through open entry and can give students and employers a choice of content, sequence and attendance patterns though these features are not widely utilized. It can allow for personalized programs of study and introduction of short courses. It can provide for more efficient use of facilities and equipment. It makes for more uniform teaching and assessing. It has a positive effect on student attitudes. The program evaluations conducted confirm the effectiveness of this teaching strategy, and staff and student preference for this type of program.

4.3 The important variables in implemented programs

4.3.1 Student variables

PSI-type individualized programs in TAFE appear to be equally suitable for high and low ability students. There is some evidence, however, that individualized programs are more suitable for maturer students (e.g. third year students evaluated by Camaren et al. (1983) rather than first year students evaluated by Harris et al. (1982)) or for students who have been out in the workforce for a while rather than students who are straight from school. Students with strong reading/study/academic skills are also more suitable candidates for PSI-type individualized programs (Camaren et al., 1983). These trends found in implemented TAFE programs in Australia resemble the trends regarding maturity and educational levels evident in the research literature. However, in neither case is there any evidence of strong

student variables by treatment interaction. An orientation program for all students is essential, but especially for less mature and less academically skilled students, who will need more teacher care and guidance. All individualized programs should still provide for peer interaction.

4.3.2 Course variables

Individualized programs in TAFE flourish in areas concerned with the development of skills, particularly practical skills and hand skills. They are useful for teaching both the theory component (knowledge) and the practical component.

There tend to be concerns regarding individualized instruction for teaching and assessing attitudinal objectives, and for teaching and assessing problem solving. There is very little research on instructional methods valuable for teaching problem solving (Frederiksen, 1984). Students can learn the higher mental processes, such as application of principles, problem solving, analytical skills and creative thinking, in individualized systems of instruction if these processes become more central in the teaching-learning process, if appropriate learning experiences are provided, and if higher mental process questions are included as part of the student assessment. In trade areas such as electronics troubleshooting or auto repair, specific rules and procedures for problem solving can be taught because of the many instances where they can be applied.

Individualized methods of instruction at present are underutilized in TAFE for teaching cognitive skills. The research literature indicates that systems of individualized instruction are effective for teaching cognitive skills, and just as effective for teaching higher level objectives as for teaching lower level objectives.

There is no evidence that individualized systems of instruction are more or less appropriate for different subject matter, i.e., there is no evidence of strong subject matter by treatment interaction.

4.3.3 Individualized instruction variables

The research literature demonstrates that the important instructional variables are: short units, immediate feedback, provision of study guides and objectives, and a mastery requirement. The effects of those variables have not been studied in TAFE but the program evaluations conducted indicate that there are design deficiencies in these areas. Problems have been experienced with specification and maintenance of performance standards, with design of learning programs and with over-reliance on written materials. Programs for practical training need audio-visual support and access to a multimedia production person is important.

The mode of presentation used (written, audiotape, videotape, etc.) does not seem to be important provided it is suitable for the students and the subject matter, and of good intrinsic quality. The over-reliance on written material has often been noted; good visual material can be provided using a low technology approach such as flipcards.

The definition of performance testing has become limited largely to assessment of psychomotor skills using a product checklist. Some programs include a process checklist. Objectives such as to calculate, to adjust, to locate, to select, to classify, are also performance objectives and provide a way of assessing higher level objectives. There is still a role for good quality objectives-referenced or criterion-referenced written tests and teachers need assistance in this area. Periodic proficiency testing can be used to assist recall and integration.

Self-pacing has been revealed by some of the program evaluations to be problematic, with student "slacking off" experienced and with a lack of incentives for faster students. The need to motivate students still remains. The research literature clearly indicates that self-pacing is not an important variable so limitations to self-pacing are recommended. Linked to the self-pacing problem is the issue of time. If students are allowed "all the time they need", how are they to develop efficient use of time? Only in secretarial studies is time built in as an important outcome. It is recommended that trade courses consider specifying time limits as an integral part of specification

of some of the performance standards and conditions. Students can have relatively unlimited numbers of attempts at achieving the objective but the objective itself can specify a time limit to build up speed. "Time is money" is still an important adage, and in most industries both cost efficiency and quality of production are important.

4.4 Curriculum development

Individualized systems of instruction can be used to achieve the following:

- (1) to increase student achievement especially in subject-based courses;
- (2) to facilitate the teaching of practical training;
- (3) to improve student and employer choice of access and content; and
- (4) to provide more efficient use of facilities and equipment.

Appropriate individualized systems of instruction are best suited to areas where there is a large amount of practical work, or areas where there are concerns regarding student cognitive achievement, for any reason. Practical work is not confined to hand skills. Simulated work conditions can be important for teaching higher level objectives and for prevocational students.

Individualized systems of instruction are also suited to areas where it is important or very desirable to provide personalized programs of study. This can allow for specialization or acceleration, or varying attendance patterns, or for combining different types of students together.

In considering the introduction of individualized programs, it is important to consider staff attitudes to the program and student maturity and educational level. Adequate provision should be made for staff training and development, and for student orientation.

If the amount of practical work is not large or if student achievement is not a problem, then the advantages of

individualized programs are not that major. The developmental costs could not be justified in these instances unless student/employer choice of access and content were major factors.

In the design of individualized programs, the important variables are: short units, immediate feedback, provision of study guides and objectives, and a unit mastery requirement. Consideration should be given to limiting self-pacing and to specifying time as an outcome. Instructional materials need to be suitable for the student and subject matter and without overreliance on written material. The amount of developmental time needed is great. If instructional materials are to be developed on a national scale, then it is worth considering developing materials that can support individualized programs.

A learner's progress is dependent upon these things:

- (1) the information, materials and situation presented,
- (2) the performance required,
- (3) the feedback provided, and
- (4) the time provided for learning.

Systems of individualized instruction provide a way of building in desirable instructional design features. They make the contingencies between presentation, performance and results explicit. Alternative methods of instruction that can be considered where the amount of practical training is not large include group-based mastery learning feedback-corrective procedures, and cooperative methods using peer tutoring and group investigation approaches. Group-based methods remain popular for teaching problem solving skills in particular.

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